Spot Scan Probe of Edge and Midline Effects in Fully-Depleted CCDs

Paul O'Connor

BROOKHAVEN NATIONAL LABORATORY

November 2013

Summary: lateral electric fields in thick Si lead to light --> charge re-mapping

“flat” field nonuniformities…

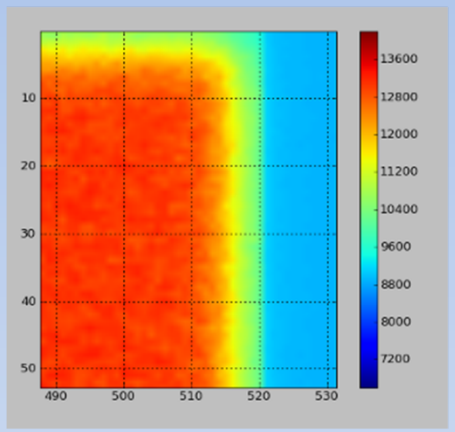
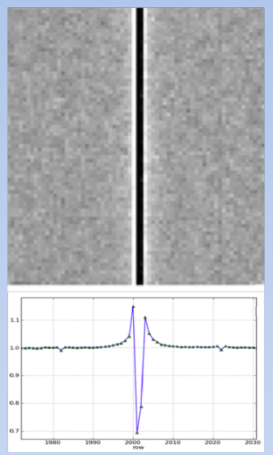
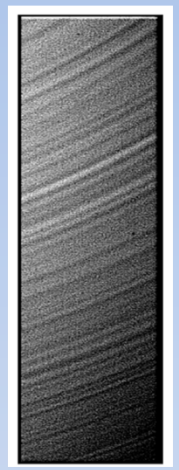


Figure 2 (a) Edge rolloff

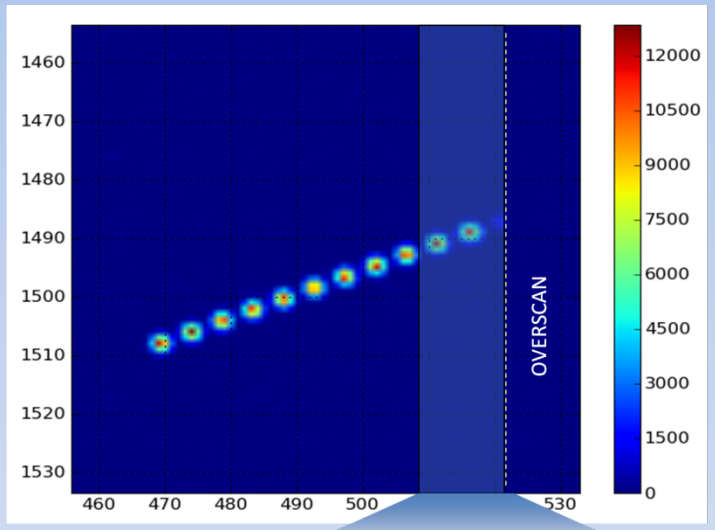


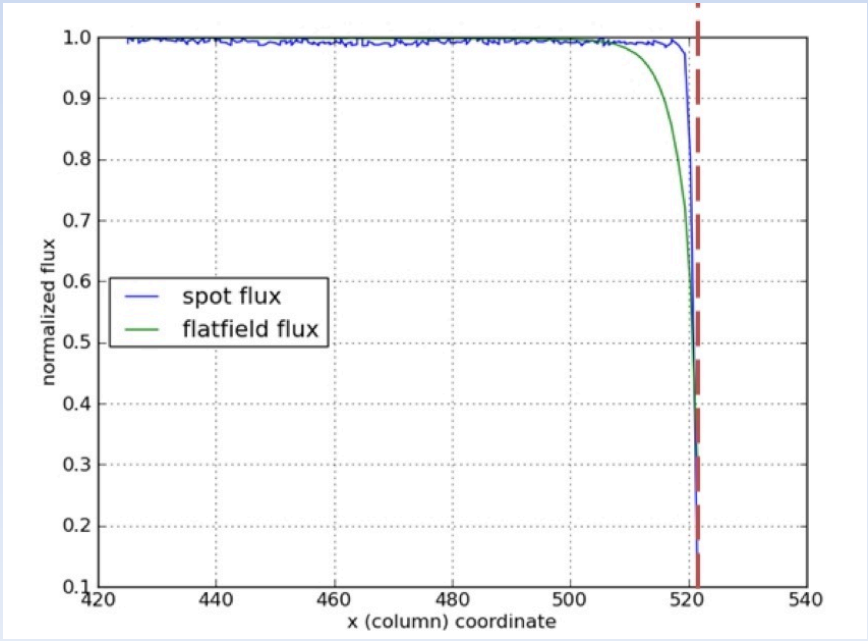
(b) Midline



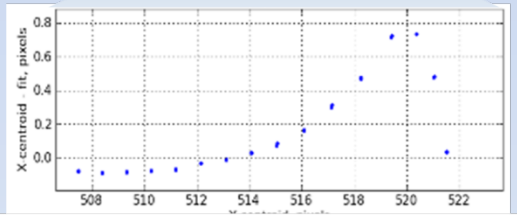
(c) “Tree rings”

… shown to be pixel area distortions, not QE variation

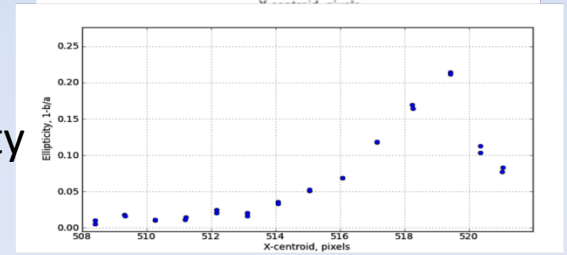


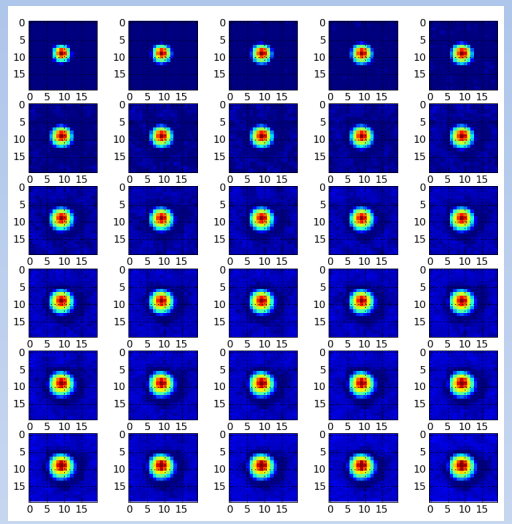


charge centroid

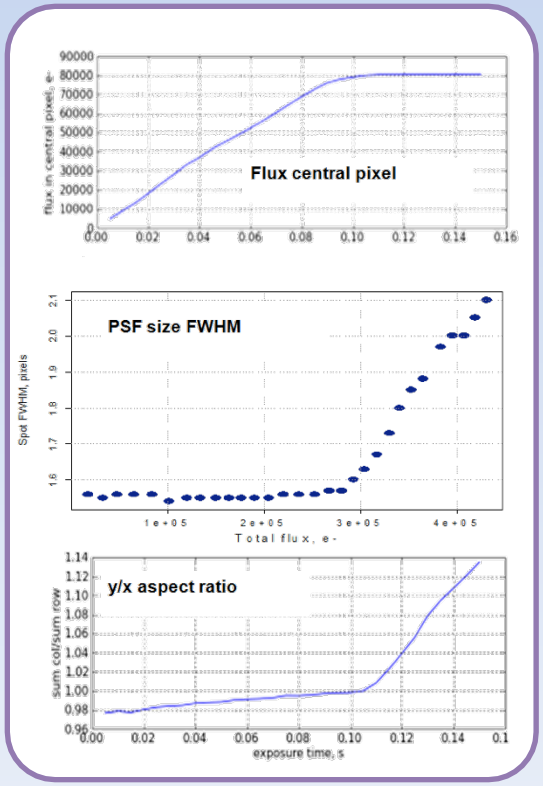


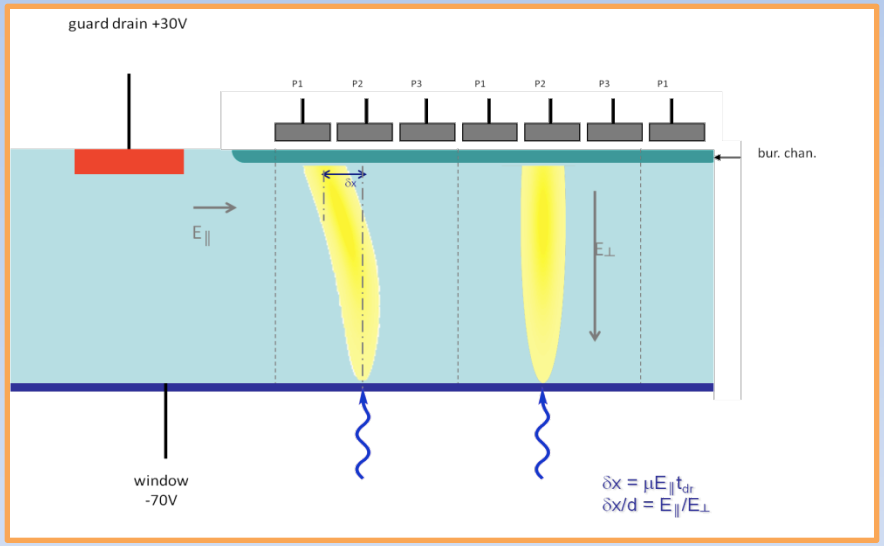
ellipticity

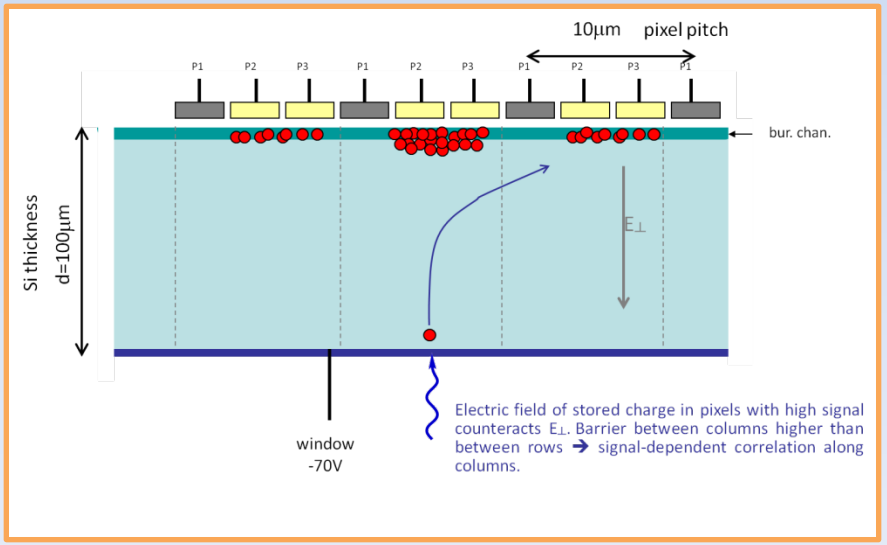




Intensity-dependent PSF can be explained by lateral field from already-collected charge



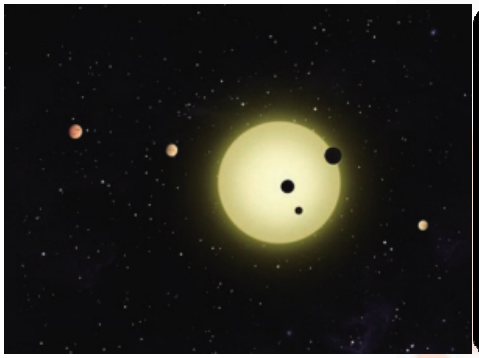


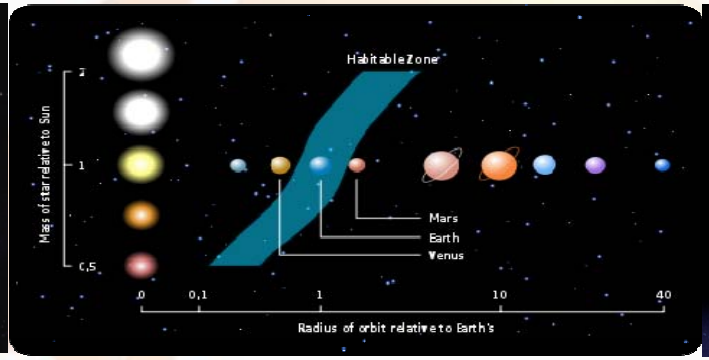


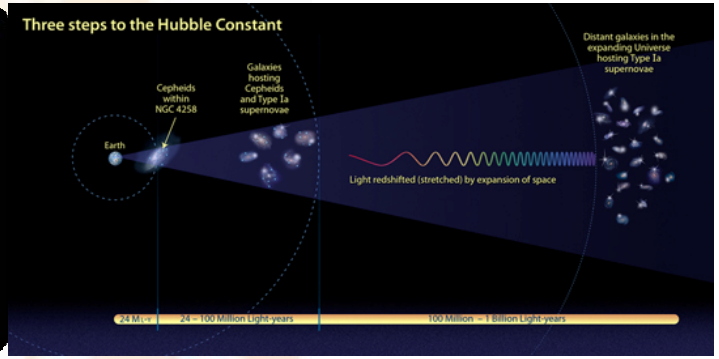
High precision Space Astromotry mission:
Search for nearby Terrestrial ExoPlanets(STEP)

Ding Chen (National Space Science Center, CAS)

➢**Science Objectives: High-precision Astrometry Mission for Extra-solar Planets detection**







- ◆**Search for nearby(d<20 pc) habitable earth twins**
- ◆**Comprehensive exploration of the structure and diversity of nearby planetary system**
- ◆**Calibration of the distance indicators of the universe**

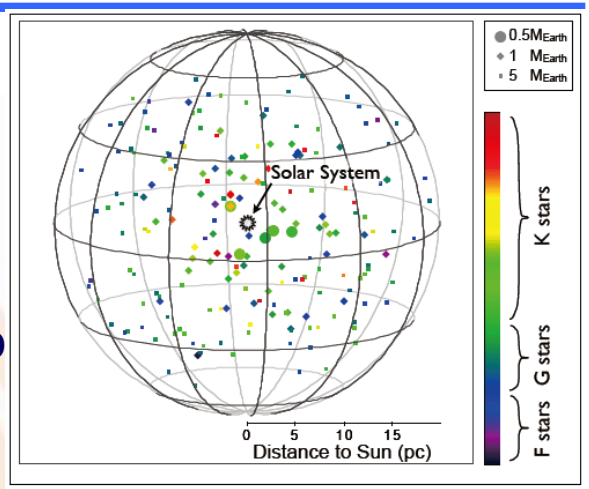
(Cepheids, improve the current accuracy from 10% to 0.3%, which will improve all the subsequent steps in the distance scale)

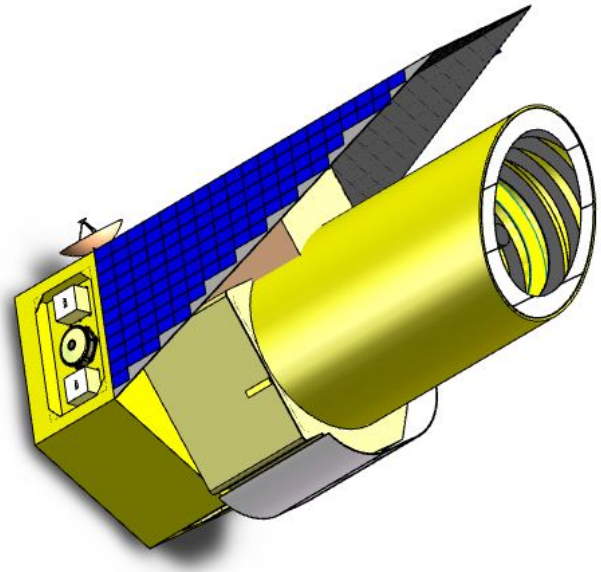
Search for Terrestrial Exo-Planets(STEP)

➢Satellite Specifications / Payloads:

- ✓**Orbit:** Solar-earth L2 Halo
- ✓**Mass:** 500 kg **Life time:** 5 year
- ✓**Payloads:** TMA, Cassegrain Astrometric Telescop

(Primary Aperture: 1.2m, f=50m, FOV: 0.44°)





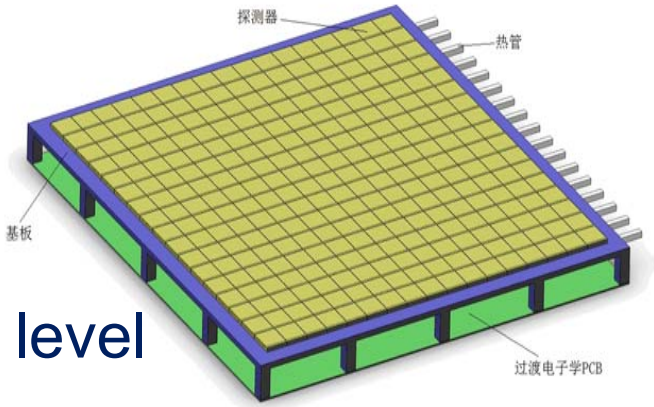
➢ Highlights

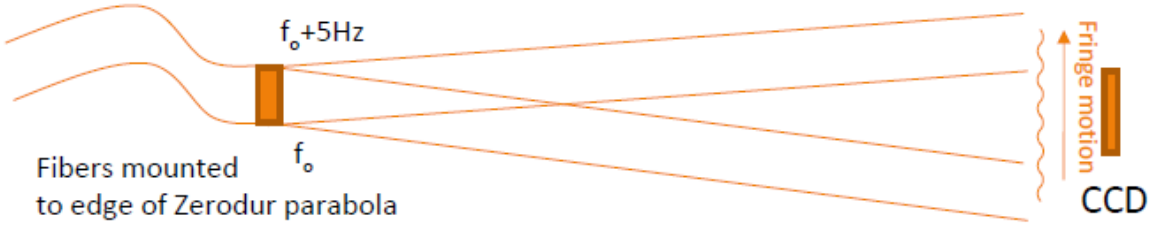
- ✓ Extremely-high-precision(1 uas) astrometric space mission
- ✓ Able to detect the habitable planets at earth criterion
- ✓ Get the actual planetary masses and the full orbital geometry for all components of the detected planetary system

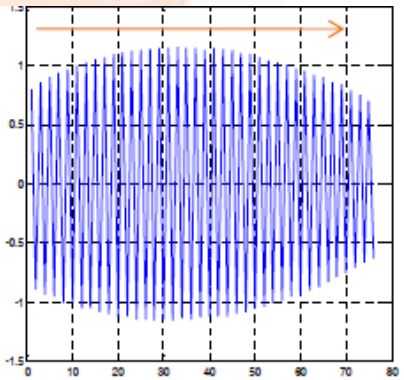
Key Technology in STEP:

Calibrating CCD Centroiding Errors!

- Two/three classes of errors
  - Pixels are not uniformly spaced
  - QE within a pixel is not uniform
  - Error in the assumed PSF
- Measuring Pixel positions at the upixel level
- Measuring QE variations within a pixel
- Nyquist sampling and measuring the PSF.
- 50Hz, Mosaic, 1e read noise, monolithic,no lenslet array





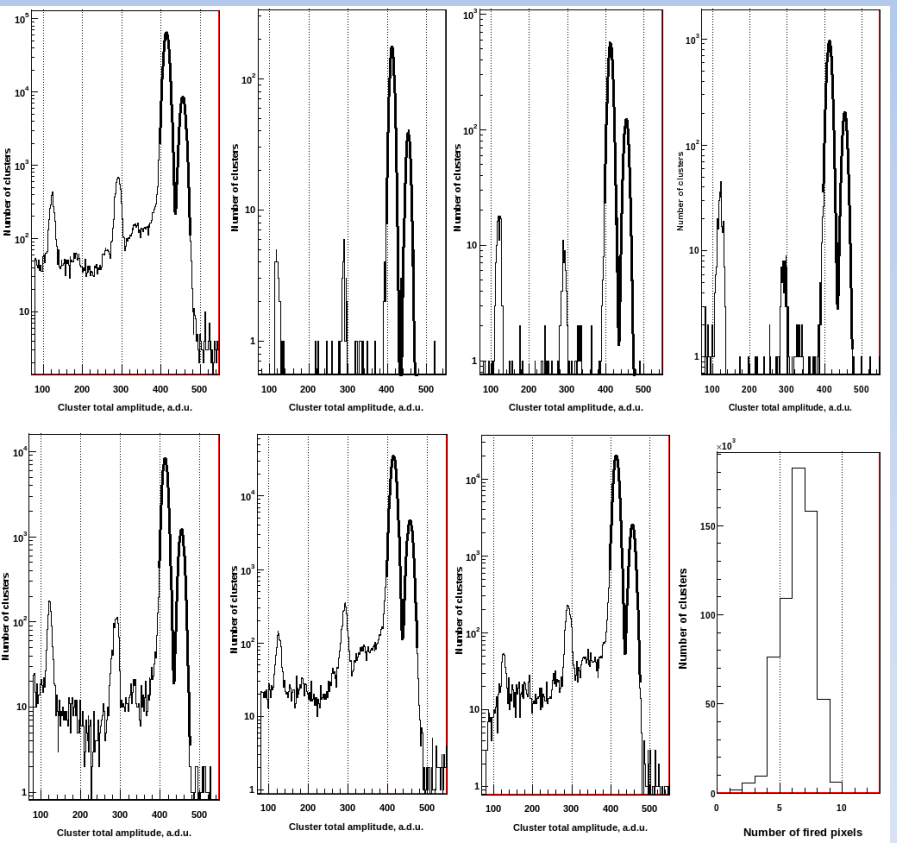


X-ray Analysis of Fully Depleted Thick CCDs with Small Pixel Size

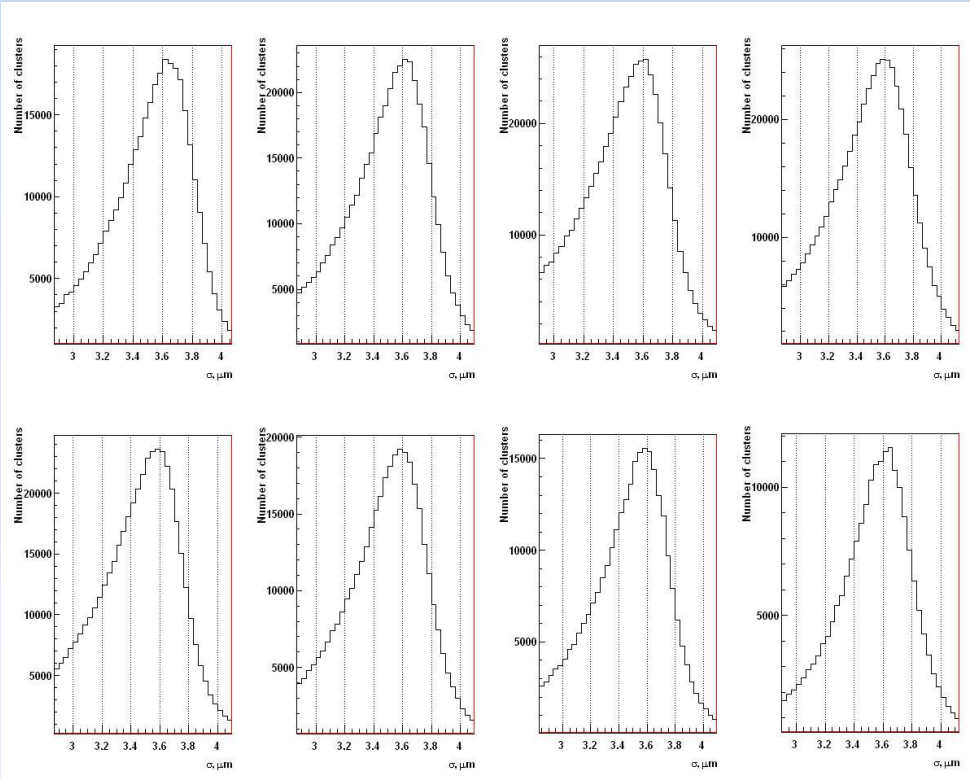
Ivan Kotov
Brookhaven National Laboratory

November 2013

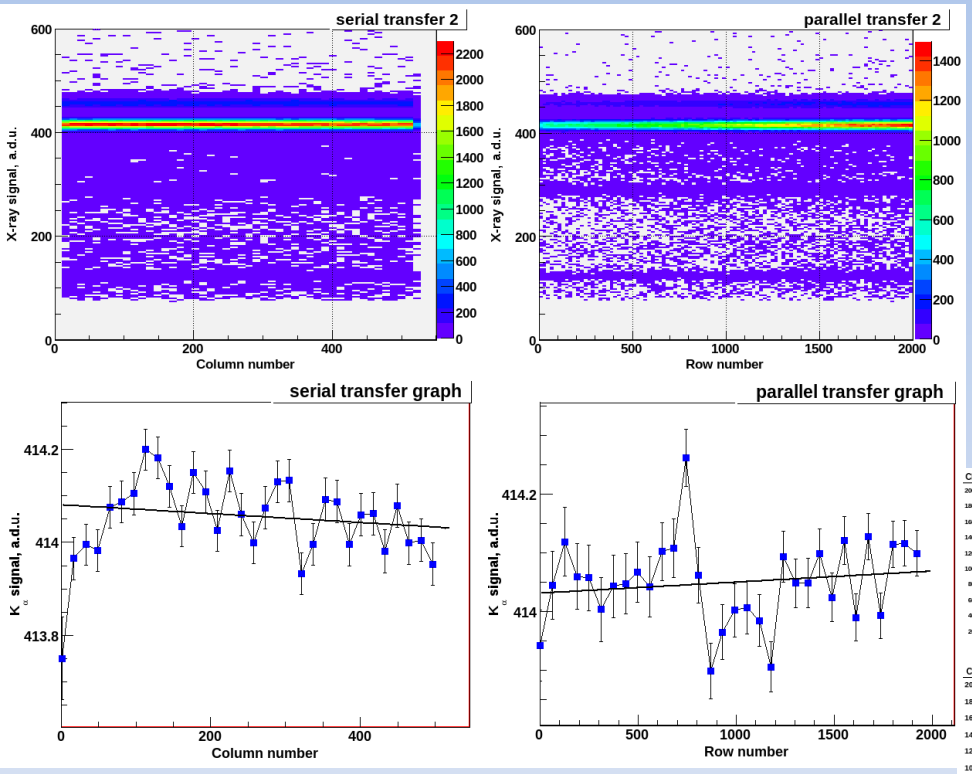
^{55}Fe analysis



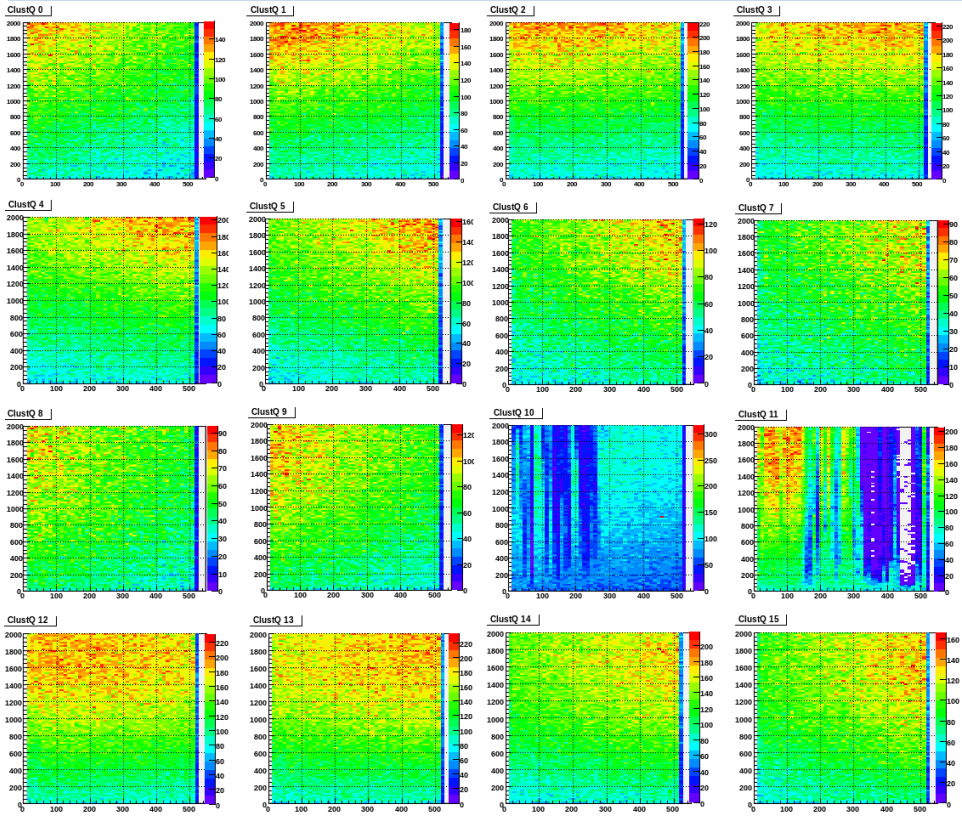
- ✓X-ray spectra: gain and linearity for small signals
- ✓Lateral diffusion sigma



^{55}Fe analysis



- ✓Charge Transfer Efficiency
- ✓Pinpoint Defect locations



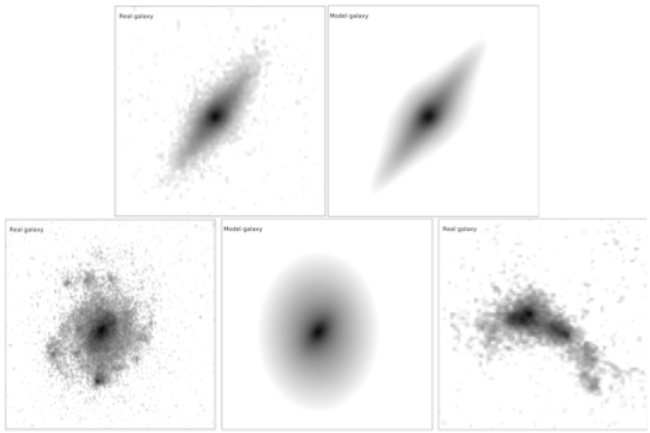
GREAT3

The third GRavitational lEnsing Accuracy Testing challenge

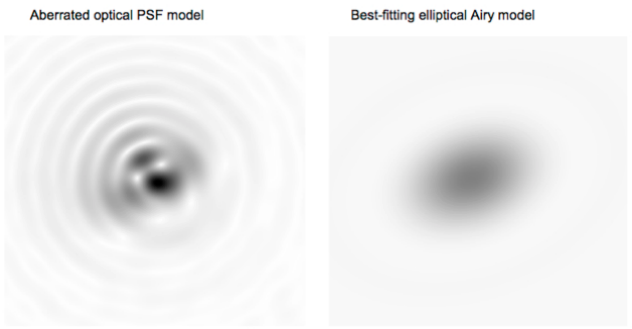
Hironao Miyatake[1], Rachel Mandelbaum[2], Barnaby Rowe[3], Gary Bernstein[4], and Mike Jarvis[4]
(on behalf of the GREAT3 collaboration; arXiv:1308.4982)
1 Princeton University; 2 Carnegie Mellon University; 3 University College London; 4 University of Pennsylvania

GREAT3 is the image analysis challenge to test and facilitate galaxy shape measurement algorithms.
%-level precision is required for upcoming weak lensing surveys

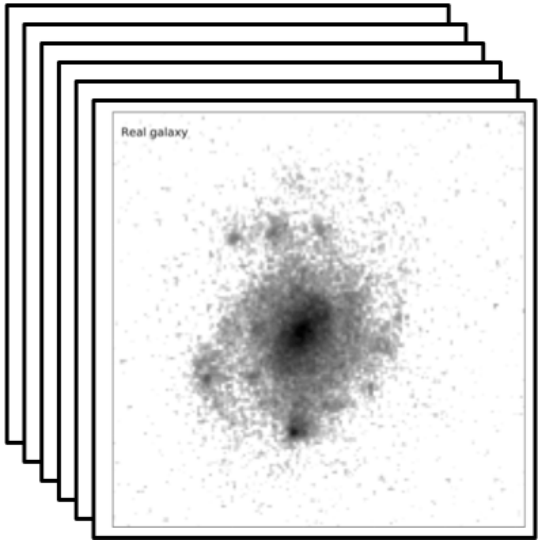
A. Realistic Galaxies



B. Realistic PSFs



C. Multiple exposures

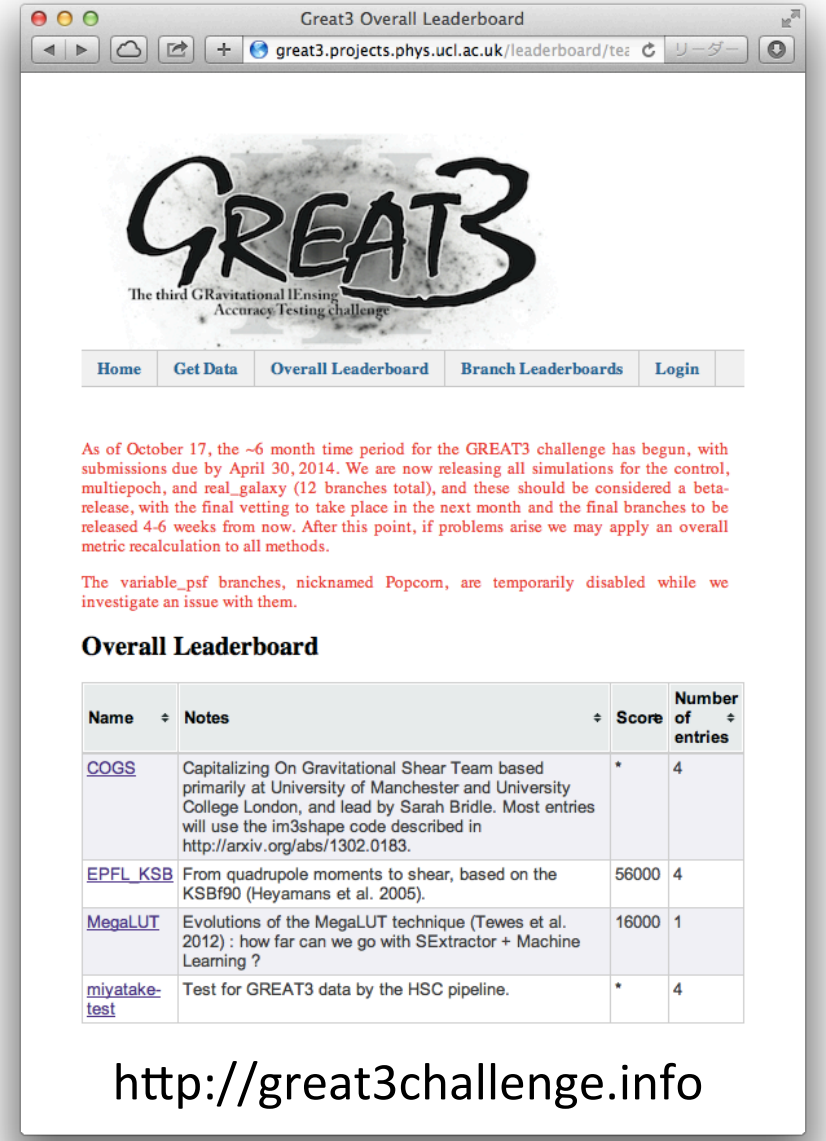


October 2013:
Public release of simulations
Challenge starts

January 6 & 7, 2014:
Mid-challenge meeting
at Edinburgh

April 30, 2014:
End of challenge

May 2014:
GREAT3 wrap-up meeting
at Carnegie Mellon University



http://great3challenge.info

Please participate in the challenge!

Impact of Chromatic Effects on Measurements of Galaxy Position, Shape and Flux

Joshua E. Meyers and Patricia R. Burchat

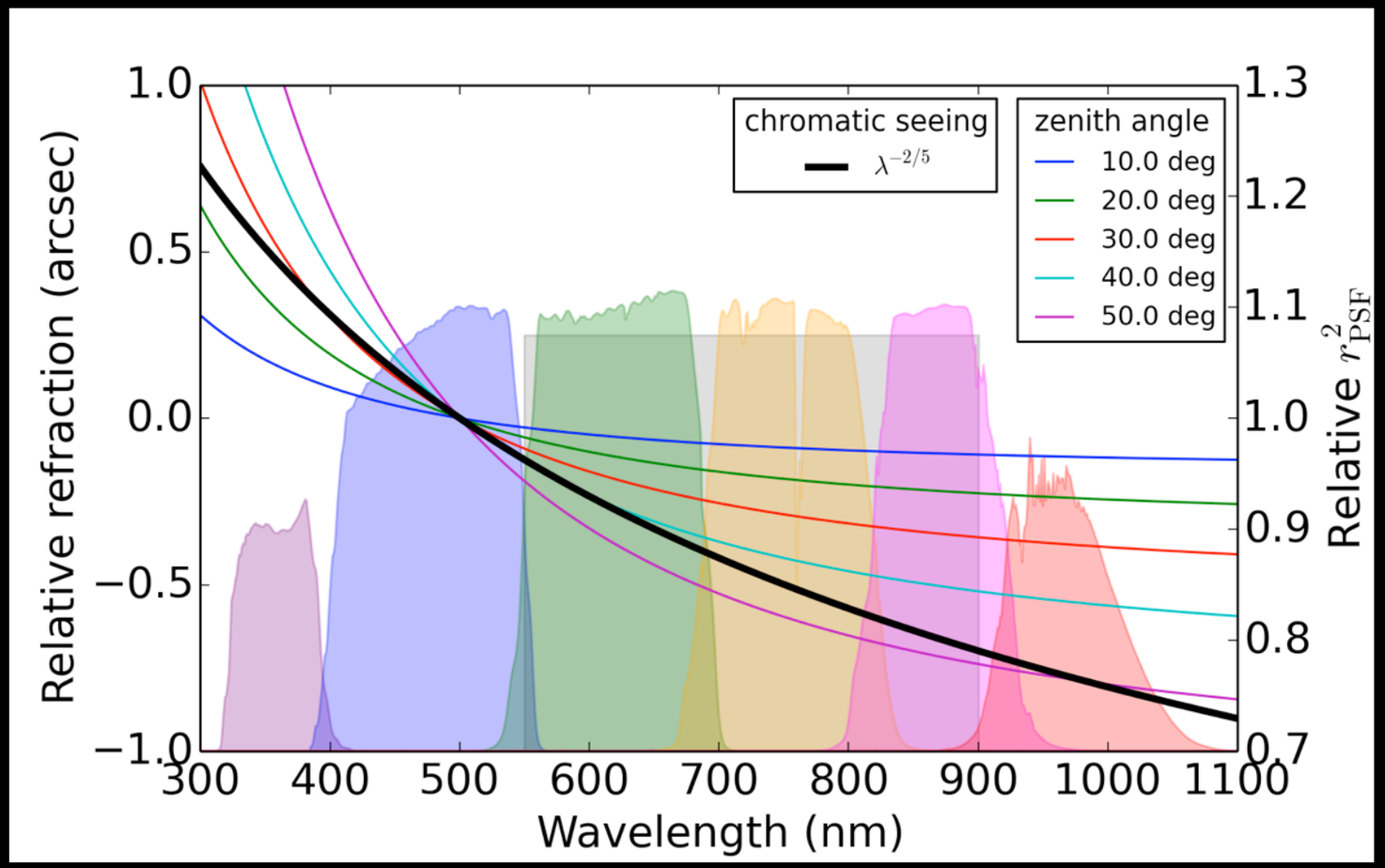
Stanford University

- Measurements of galaxies depend on measurements of stars since we deconvolve galaxy images using stellar-derived PSF

- Approach assumes stellar PSF is the same as galactic PSF.

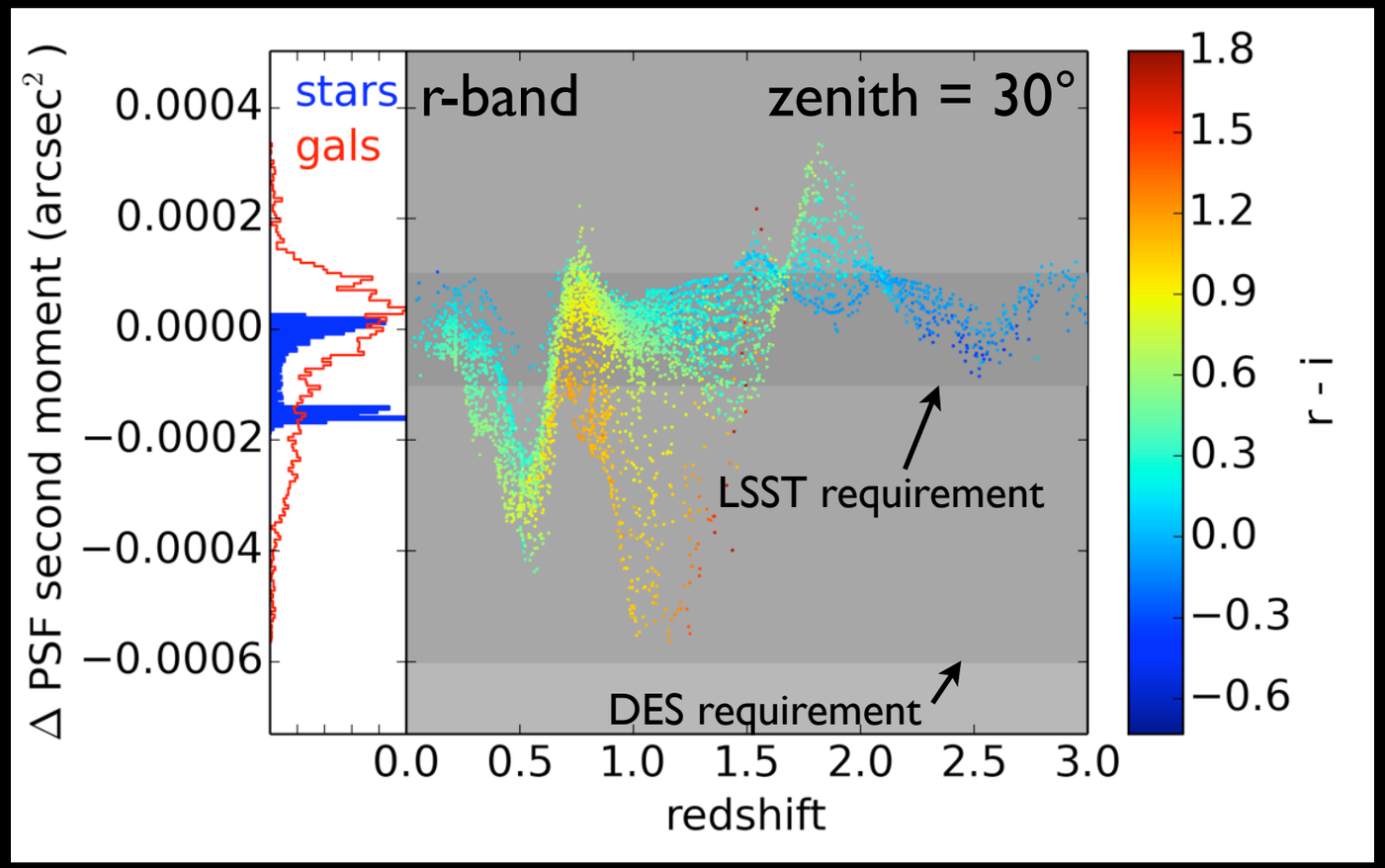
- Chromatic PSFs violate this assumption.

Chromaticity in atmospheric effects



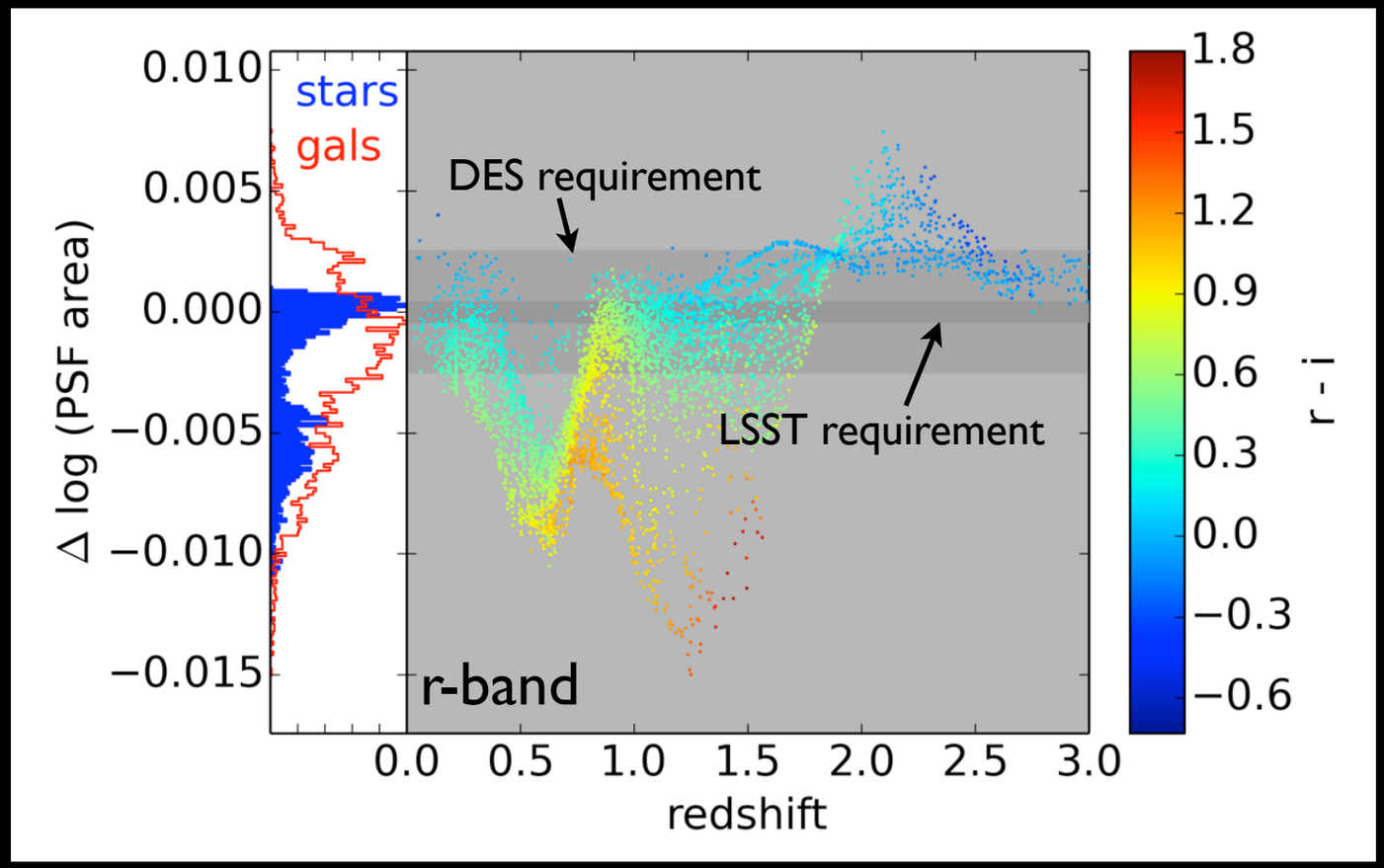
- Differential chromatic refraction: blue photons refract closer to zenith than red photons

- Introduces SED-dependent shift and stretch of PSF along zenith direction.



- Wavelength dependence of seeing: blue photons get smeared out more by atmospheric turbulence than red photons.

- Introduces SED-dependent change in PSF size.

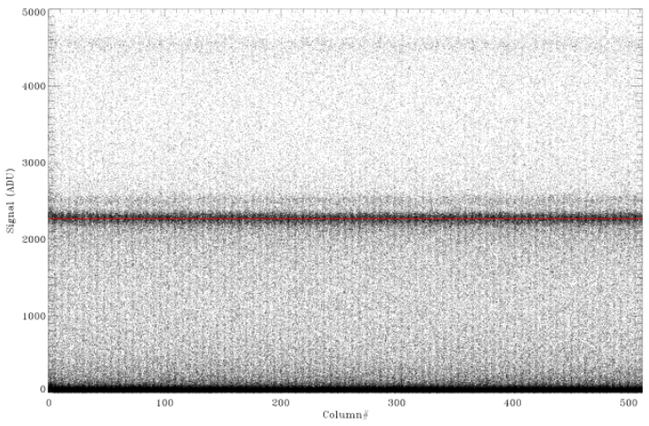


PAU, a Fully Depleted Mosaic Imager with Narrow Band Filters

A.Bauer, F.Castander, S.Serrano

the Camera

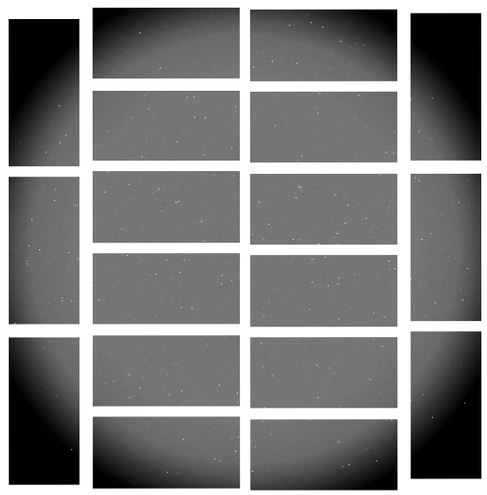
and CCD Characterization



the Survey

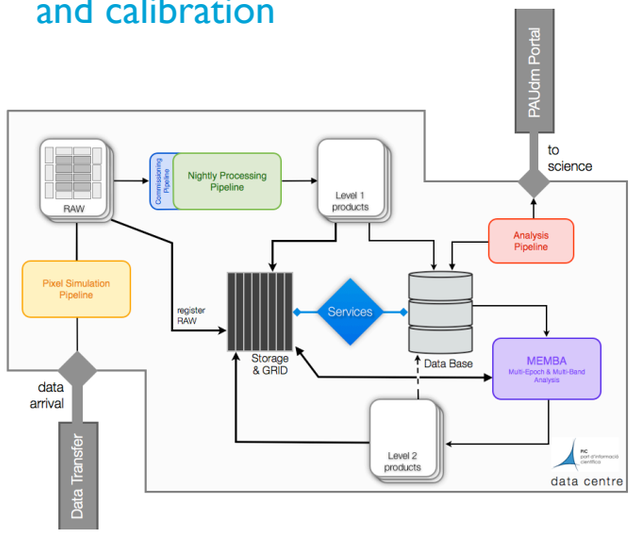
The PAU Survey studies the existence and properties of **dark energy** from the observations of ~10^7 galaxies in 200 deg^2 of extragalactic sky area up to redshift 1.

the Simulation

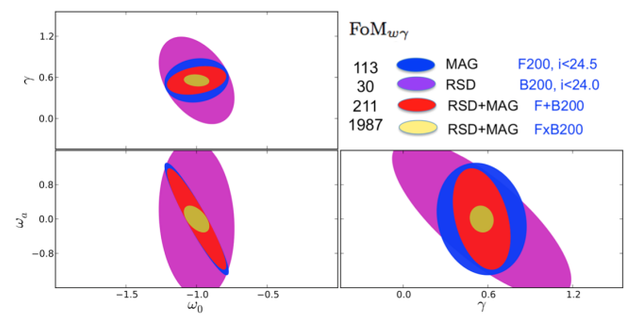


the Data Management

and calibration



the Science

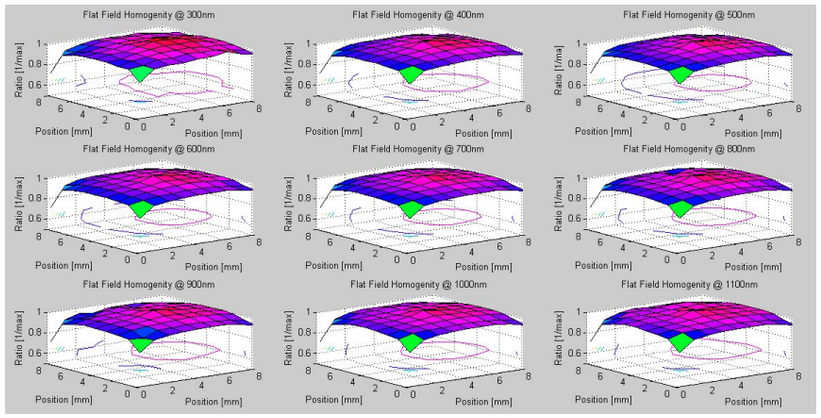


IEEC IFAE ICE CSIC PIC port d'informació científica Ciemat

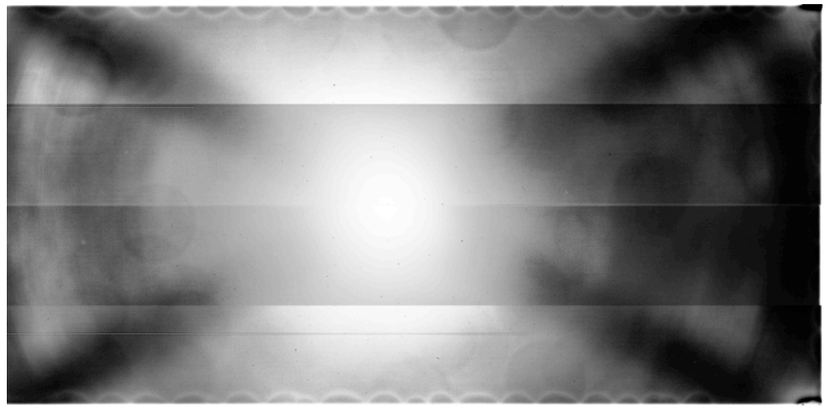
PAU, a Fully Depleted Mosaic Imager with Narrow Band Filters

A.Bauer, F.Castander, S.Serrano

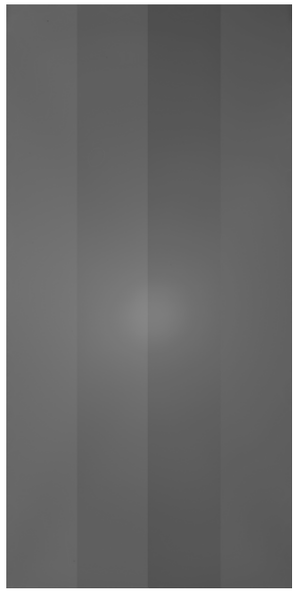
HPK Fully Depeleted CCD Detectors Characterization



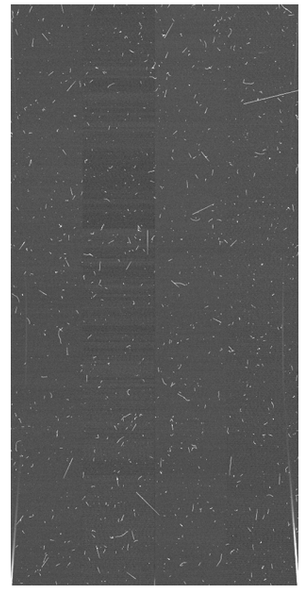
Planartity



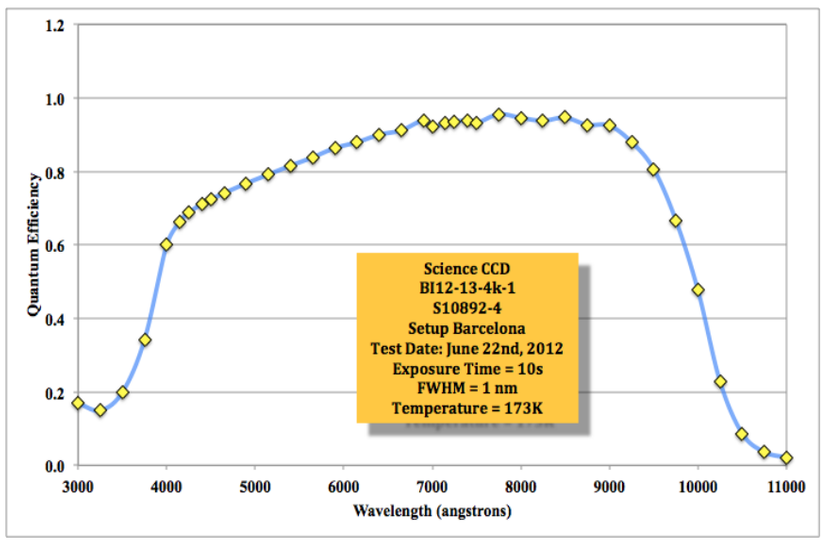
High Contrast Ilumination Image



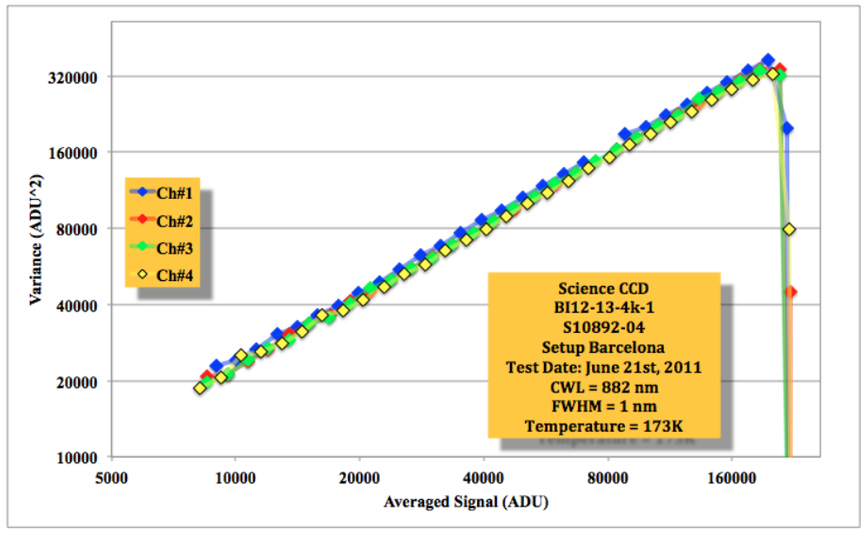
Flat Field



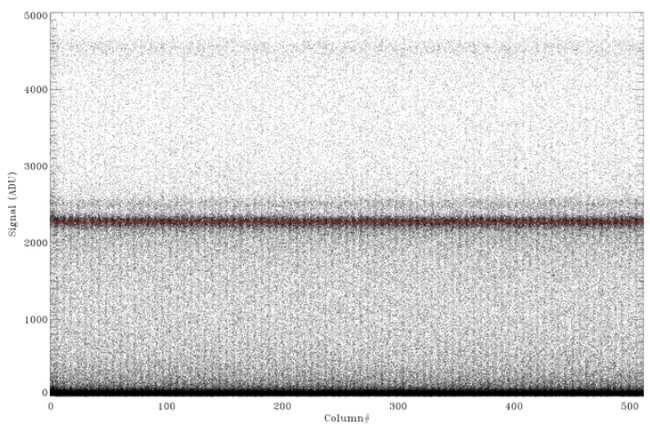
Dark Image



QE



PTC



X-Ray CTE test

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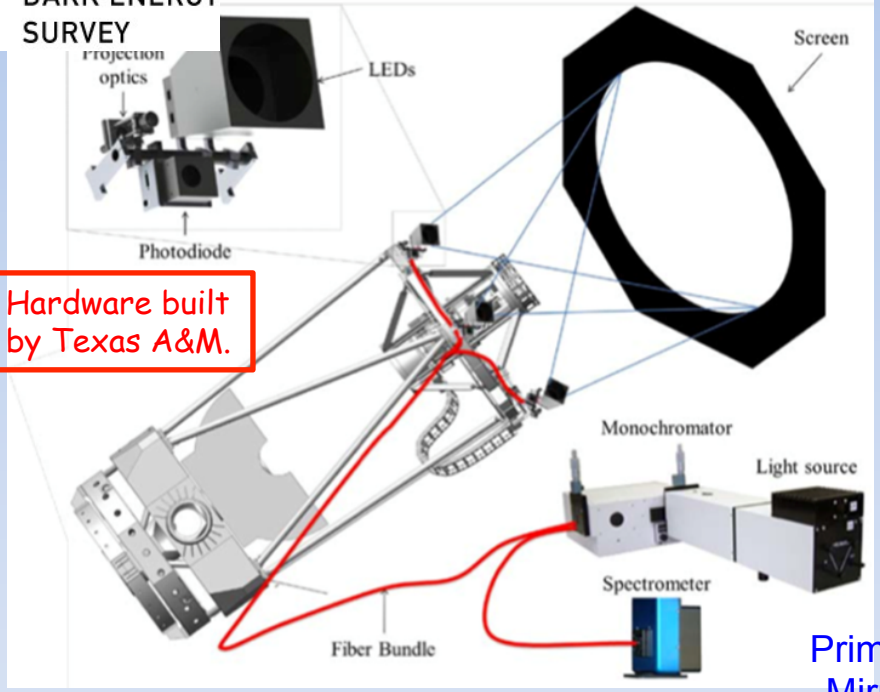
DECal Calibration System

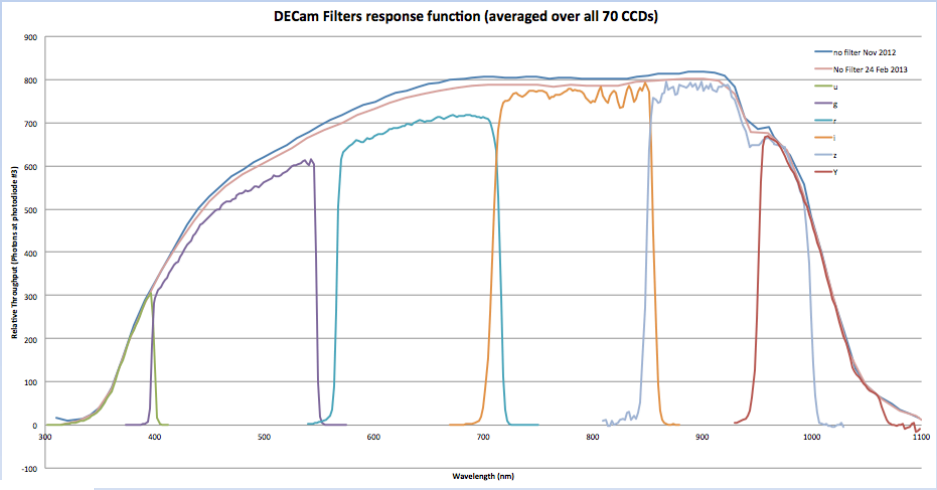
Analysis of the Spectrophotometric Flat Field System for the DECam Instrument in support of the Dark Energy Survey at the CTIO Blanco 4m Telescope

DARK ENERGY SURVEY

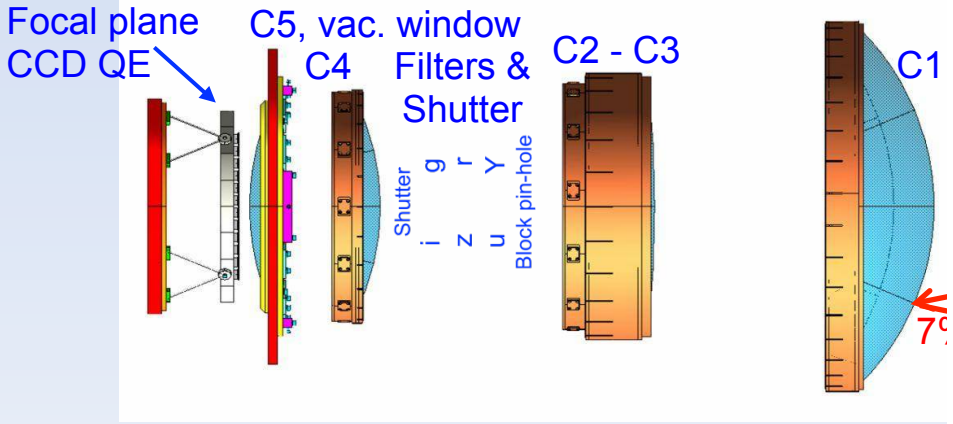


Hardware built by Texas A&M.

Measure the total system throughput (less atmosphere) as a function of wavelength, focal plane position, and time.



Primary Mirror



It is not too difficult to generate a response function vs wavelength, position, and time … but there are details such as illumination, pupil ghost effects, and other instrumental signatures and the overall relevance of flat fields to astronomical images.